

FIELD OF THE INVENTION

The present invention relates to an ancillary tool for positioning an acetabular prosthesis in an anatomical or prosthetic cavity of a patient's hip, of the type comprising a handle for manipulating the acetabulum provided, in its distal part, with a head for gripping the acetabulum and, in its proximal part, with a surface for application of a force of impaction.

BACKGROUND OF THE INVENTION

This type of ancillary tool, commonly called "gripper/impactor tool", is used during surgical operations for implanting a rigid acetabulum, generally made of metal, in the patient's hip. Once the acetabulum has been implanted in the bone, a polymer cup is housed in the acetabulum, this cup being itself intended to receive the hemispherical head of a femoral implant or of the anatomical femur. The polymer cup is either connected directly to the acetabulum, by wedging of corresponding truncated surfaces borne by the cup and the acetabulum, or connected to a metallic shell which is received in articulated manner, substantially in the manner of a ball-and-socket joint, in the acetabulum fixed to the bone. A cotyloidal assembly with double mobility is spoken of in the latter case.

A first example of this type of ancillary tool consists in a rigid handle at the distal end of which is permanently connected a head made of supple plastics material, such as ertafluor (Registered Trademark). This head, whose outer dimensions are slightly greater than the inner dimensions of the acetabulum to be implanted, is introduced and wedged in this acetabulum, allowing gripping then positioning thereof up to the location of impaction of the hip. However, the use of such a one-piece head presents numerous drawbacks, as the supple material used does not allow an efficient grip if the inner dimensions of the acetabulum are not adapted to those of the head, this often obliging the surgeon

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to seize the acetabulum to be implanted in one hand, in order to wedge the head efficiently. The conditions of sterility are therefore not always respected.

Moreover, the supple material of the head is often difficult to sterilize.

Furthermore, once the impaction of the acetabulum is effected, it is generally
5 difficult to disengage the head wedged in the acetabulum.

U.S. Patent No. 5 169 399 discloses another example of such a tool in which a gripper/impactor handle is adapted for positioning a prosthetic assembly constituted by a metallic acetabulum and a polymeric insert, the acetabulum and the insert being positioned and impacted simultaneously by the handle. The
10 latter presents at its distal end a split head whose two jaws are spaced apart from each other by a compression spring. When the surgeon brings the two jaws towards each other by compressing the spring, the head may be introduced inside the polymeric insert, then, by releasing one of the jaws, the prosthetic assembly formed by the insert and the acetabulum retained on the insert
15 undergoes a gripping effort by the head. This tool is complex to make and to manipulate, the effort of grip depending directly on the force of the compression spring interposed between the jaws of the head. Moreover, insofar as the zone of contact between the head of the tool and the prosthetic assembly is formed by the end part of the polymeric insert of greatest diameter, the effort of impaction
20 applied by the handle on the prosthetic assembly cannot attain high values without risk of damage to the insert and the guiding of the acetabulum by the head during impaction is unreliable. Under these conditions, there is no guarantee that the surgeon will not use one of his hands to hold the prosthetic assembly during grip thereof by the tool. Furthermore, this tool is not applicable
25 to the positioning of a cotyloidal assembly with double mobility set forth hereinabove, the grip of the insert not ensuring hold of the acetabulum to be implanted.

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Document WO 95/11641 discloses another tool of the afore-mentioned type, which further comprises a metallic endpiece removably added to the distal end of the handle for manipulating the acetabulum to be implanted. A deformable member of the endpiece is constituted by four quadrants, namely

5 two diametrically opposite rigid quadrants fixedly connected to a proximal part of the endpiece by bridges of matter, and two diametrically opposite mobile quadrants, each connected to one of the rigid quadrants by an elastically deformable hinge. Pivoting of the two mobile quadrants is controlled by screwing the handle in the proximal part of the endpiece. However, the use of

10 these two mobile quadrants ensures an efficient wedging of the acetabulum only in two diametrically opposite zones of its inner face, in other words only with a limited gripping force.

It is an object of the present invention to propose a tool which is adapted to acetabula of different dimensions and nature and which ensures both an

15 efficient grip of the acetabulum and a good application of the force of impaction, without hindering the withdrawal of the tool once positioning has been effected.

SUMMARY OF THE INVENTION

To that end, the invention relates to an ancillary tool for positioning an acetabular prosthesis in an anatomical or prosthetic cavity of a patient's hip

20 comprising a handle for manipulating the acetabulum provided, in its distal part, with a head for gripping the acetabulum and, in its proximal part, with a surface for application of a force of impaction, and at least one added endpiece adapted to be removably connected to the distal end of the handle and defining both a face for wedging the acetabulum and an opposite face for interaction of the

25 endpiece with the head of the handle, wherein the endpiece comprises a supple ring radially deformable with respect to the longitudinal axis of the endpiece, on which are formed the wedging and interaction faces.

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The use of the radially deformable ring makes it possible both to guarantee an efficient grip, the surgeon being able to control hold of the endpiece by the head of the handle, and to efficiently transmit at least a part of the effort of impaction up to the acetabulum. By having available a series of
5 endpieces of different sizes, the surgeon is able to use the same manipulation handle for positioning acetabula of different dimensions and/or nature.

According to other characteristics of this ancillary tool, taken separately or in all technically possible combinations :

- 10 - the ring is radially deformable over substantially the whole of its periphery ;
- the face of the endpiece intended for wedging the acetabulum is constituted by substantially the whole outer face of the ring ;
- the endpiece comprises both a supple part including the deformable ring and a rigid part fast with the supple part and provided with means for removable
15 connection to the distal end of the handle ;
- the rigid part of the endpiece is constituted by a metallic insert fixed to the supple part ;
- the deformable ring is elastically connected to a base of the supple part ;
- the deformable ring comprises a plurality of petals, the wedging and
20 interaction faces being respectively constituted by the outer and inner surfaces of each of these petals ;
- the rigid part of the endpiece defines a stop surface, in the longitudinal direction of the handle, for the head of the handle ;
- the supple part of the endpiece presents at least one surface for
25 transmission of the force of impaction between the handle and the acetabulum.
- the head of the handle defines a ramp surface adapted to cooperate with the interaction face of the endpiece ;

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- the handle comprises a rigid rod on which the head is movably mounted, as well as means for driving the head with respect to the rod in a movement of translation in the longitudinal direction of the rod ;

- the handle comprises a sleeve disposed coaxially to the rod and at the distal end of which the head is rigidly fixed and the means for driving the head with respect to the rod comprise a grip screwed on the rod and connected in translation with the sleeve, this sleeve being immobilized in rotation with respect to the rod ;

- a ring is axially interposed between the sleeve and the screwed grip.

The invention also relates to a method for positioning an acetabular prosthesis in an anatomical or prosthetic cavity of a patient's hip, comprising the steps of:

- using, on the one hand, a handle for manipulating the acetabulum, provided, in its distal part, with a head for gripping the acetabulum and, at its proximal end, with a surface for application of a force of impaction, and, on the other hand, a series of endpieces of different dimensions and/or geometry, each comprising a supple ring radially deformable with respect to the longitudinal axis of the endpiece, on which are formed both a face for wedging the acetabulum and an opposite face for interaction of the endpiece with the head of the handle,

- selecting, from the series of endpieces, an endpiece of which the wedging face is substantially complementary of the inner wall of the acetabulum to be positioned,

- connecting the endpiece to the distal end of the handle,

- placing the endpiece in the acetabulum,

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- placing the endpiece in engagement by the head of the handle so as to provoke radial deformation of the ring and consequently grip of the acetabulum by the endpiece,

- positioning the acetabulum in the cavity of the patient's hip,

5 - applying a force of impaction on the corresponding surface of the handle,

- disengaging the head from the endpiece, and

- withdrawing the endpiece from the positioned acetabulum.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The invention will be more readily understood on reading the following description given solely by way of example and with reference to the accompanying drawings, in which:

Figure 1 is an exploded view in perspective of an ancillary tool according to the invention, and of an acetabular prosthesis.

15 Figure 2 is a longitudinal section through the tool of Figure 1.

Figure 3 is a view of detail III in Figure 2.

Figure 4 is a longitudinal section of a variant endpiece of the tool of Figure 1.

20 Figure 5 is a longitudinal section of a part of the tool provided with the endpiece of Figure 4, and

Figure 6 is a longitudinal section through a variant of a tool according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, and firstly to Figures 1 to 3, an ancillary
25 tool 1 for positioning a metallic acetabular prosthesis 2 is shown. This tool essentially comprises a handle 4 extending about an axis X-X and an added endpiece 6 adapted to be removably connected to the distal end of the handle.

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The acetabulum 2 comprises a substantially hemispherical inner wall 2a and is intended to form, with an internal shell (not shown), a cotyloidal assembly with double mobility as set forth hereinbefore.

The handle 4 comprises a rigid rod 10 at the proximal end of which is
5 rigidly fixed a knob 12. This knob presents a slightly convex proximal surface 14, forming a surface for application of a force of impaction.

Passing from the proximal end of the rod 10 towards its distal end, the rod comprises a first cylindrical section 15 on which is fixedly added a knob 16 for manipulation, connected to the rod by, for example, a tapered pin 18. The rod
10 then comprises a threaded section 20 of diameter larger than the section 15, then a smooth section 22 of smaller diameter and on the outer surface of which is formed a longitudinal groove 24. The distal end of the rod is formed by a projecting catch 28 coaxial to the axis X-X and threaded.

The handle 4 also comprises a tubular sleeve 32 mobile with respect to the
15 rod 10 and arranged coaxially to sections 20 and 22. This sleeve is provided at its distal end with a head 34 whose outer shape is truncated and convergent towards the distal end of the handle. Consequently this head defines a truncated ramp surface 36 as well as a substantially planar distal surface 38.

The proximal end of the sleeve 32 forms a substantially cylindrical foot
20 40 from which a projecting end flange 42 extends radially.

The foot 40 is provided with a cylindrical pin 44 which extends inside a substantially complementary recess formed in a direction radial with respect to axis X-X. The length of this pin is greater than the thickness of the foot, with the result that a part of the pin extends inside the sleeve 32 and is engaged in the
25 longitudinal groove 24 of the rod 10. The sleeve 32 is thus immobilized in rotation with respect to the rod, but free to move in a movement of translation in the direction X-X.

The ancillary tool 1 comprises means for driving the sleeve 32 in translation with respect to the rod 10, these means being in the form of a tubular body 46 of generally cylindrical shape and essentially disposed coaxially with respect to the threaded section 20. Internally, the body 46 defines a tapping 48
5 complementary of the section 20 of the rod 10. At its distal end, the body 46 is provided with two diametrically opposite re-entrant flanges 50 spaced apart from each other by a distance greater than the outer diameter of the end flange 42 of the sleeve 32. Consequently, these flanges 50 form for the sleeve 32 hooks for drive in direction X-X. Externally, the body 46 presents flat portions 52
10 ensuring correct grip of the body with a view to urging it in a movement of rotation about its axis.

A ring 54, made of synthetic material, for example polyacetal, is axially interposed between the sleeve 32 and the tubular body 46. More precisely, this ring comprises a cylindrical body 56 presenting an outer thread complementary
15 of the thread of the tapping 48, and an annular skirt 58 of outer diameter greater than the diameter of the recess 48. The skirt 58 forms a protective layer for the sleeve 32 when the rod 10, and therefore the body 46 screwed on this rod, is under stress, by application of a force of impaction on the knob 12.

As for the endpiece 6, it extends about an axis Y-Y, coaxial to axis X-X in
20 Figure 2. It is formed by a supple body 60, constituted for example by polyacetal, and by a metallic insert 62 connected to the body 60 by, for example, a pin 88.

More precisely, the body 60 comprises a hemispherical base 64 whose outer shape is substantially complementary of the inner wall 2a of the
25 acetabulum 2, as well as a ring 66 of petals 68 connected to the base 64 by elastically deformable connecting zones 70. By simultaneous deformation of these zones 70, the ring 66 presents a considerable capacity of radial

deformation with respect to axis Y-Y. In other words, the ring 66 is radially deformable over substantially the whole of its periphery, the petals 68 being able to move apart radially in homogeneous manner.

To that end, the ring 66 defines a face 72 for wedging the acetabulum 2, constituted by the outer surfaces 74 substantially in the form of spherical frustum of each of the petals 68, and a face 76 for interaction of the endpiece 6 with the head 34 of the sleeve 32, constituted by the inner surfaces 78 of the petals 68 which form counter-ramp surfaces for the ramp surface 36 of the head 34. Each inner surface 78 comprises a cylindrical part extended rearwardly by a flared part convergent towards the base 64.

The metallic insert 62 is formed by a cylinder 80 from which a flange 82 extends radially at one of its ends. The cylinder 80 is screwed in the base 64 of the body 60 and forms a tapping 84 complementary of the projecting catch 28 fast with the rod 10. The flange 82 forms a stop surface 86 for the planar surface 38 of the head 34.

The ancillary tool 1 is used as follows.

Considering the handle 4 in the mounted state as shown in Figure 2, the surgeon introduces the distal end of the rod 10 in the endpiece 6, rendering axes X-X and Y-Y coaxial. The endpiece 6 is connected to the handle 4 by screwing the catch 28 in the tapping 84 of the insert 62. The surgeon then grips the tool in one hand at the level of the manipulation knob 16 and in the other hand at the level of the body 46 forming grip, and rotates the grip 46 with respect to the rod 10 in clockwise direction, observing the body from its proximal end. In the manner of a screw-nut system, the grip 46 pushes the sleeve 32 in a movement of translation along axis X-X, taking the head 34 inside the ring 66 of the endpiece. By continuing this drive movement, the ramp surface 36 cooperates with the counter-ramp surfaces 78 borne internally by the petals 68 so as to

radially expand the ring 66 and thus apply the outer surfaces 74 of the petals against the inner wall of the acetabulum 2. In other words, the ring 66 passes from a configuration of rest to an outwardly expanded configuration, of which the substantially circular outer contour presents a diameter greater than that of the contour of the ring in its configuration of rest. It will be understood that the whole outer face 74 of the ring 66 then participates in the wedging of the acetabulum 2. In this respect it will be noted that, for the tool 1 shown, the petals 68 of this ring are identical, which does not limit the invention in that the radial deformation of the ring by the head of the tool must be provided in particular to bring about the virtually simultaneous abutment of the essential of the outer surface of the ring on the inner concave face of the acetabulum to be manipulated.

The surgeon continues this movement until he considers that the endpiece is sufficiently retained by the head to guarantee a correct grip of the acetabulum by the endpiece by wedging. The stop surface 86 borne by the endpiece avoids any risk of excessive deformation of the petals, the insert 62 thus imposing a maximum axial position for the head 34.

The surgeon then manipulates the acetabulum freely with the aid of the ancillary tool 1, positions it on the patient's hip at the level of an anatomical cavity or a prosthetic one, i.e. formed by a previously implanted bone-reconstructing plate. Then, with the aid of a suitable hammer, he applies a force of impaction on the surface 14. The effort of impaction is transmitted in the direction X-X of rod 10 to the rigid insert 62 which is screwed on this rod, then from the insert to the base 64 of the supple body 62, and finally from this base to the acetabulum 2 through the outer surface 64a of the base, causing the acetabulum to be force-fitted in the corresponding cavity of the hip.

Once the impaction is effected, the surgeon rotates the grip 46 with respect to the rod 10 in anti-clockwise direction so as to disengage the head 34 from the endpiece 6. By elastic return deformation of the connecting zones 70, the petals 68 resume their initial position, making it possible to withdraw the
5 endpiece from the implanted acetabulum without effort.

The ancillary tool according to the invention thus makes it possible easily to manipulate an acetabular prosthesis to be implanted, and with precision. The surgeon is at no moment obliged to touch the acetabulum with his hands. The effort of impaction is efficiently transmitted to the acetabulum, in the
10 longitudinal direction of the handle 4, and this through the supple part of the endpiece. The risks of marking, and even damaging the impacted acetabulum are thus limited, unlike the impactor tools disclosed in the prior art, such as those envisaged in U.S. Patent No. 5 169 399 and WO-95/11641 mentioned
15 hereinbefore, for which hard parts of the tools are applied directly on the edge of the acetabulum, in other words at the level of a fragile zone of restricted area.

The ancillary tool according to the invention advantageously comprises a series of endpieces whose dimensions and geometries are different. For example, this series comprises, in addition to endpiece 6, an endpiece 6' shown in Figure 4, having the same general structure as the endpiece 6, but of which
20 the outer face of the supple body is formed for an acetabulum whose inner wall is partly truncated. This endpiece is adapted for the grip and impaction of acetabula in which a polymeric insert is directly connected by wedging.

More precisely, the endpiece 6' is essentially constituted by the same elements as the endpiece 6, these latter having the same reference figures to
25 which a prime is added. In this way, endpiece 6' comprises a body 60' of supple material and a rigid insert 62', rigidly fixed to each other by a screw 88'. Apart from the geometry of its outer face, endpiece 6' of axis Y'-Y' differs essentially

from endpiece 6 by the shape of its petals 68' and the zones 70' for connection with the base 64'; the outer face 74' of each petal 68' is truncated, convergent towards the base, the inner face 78' of each petal is flared over the whole of its length and the connection zones 70' extend parallel to axis Y'-Y'.

5 As shown in Figure 5, the head 34 of the handle 4 is then equipped with a bush 90 connected to the rest of the sleeve 32 by a retaining clip 92. This bush increases the outer dimension of the head 34 so as to adapt the latter to the endpiece 6' and thus laterally defines a ramp surface adapted to cooperate with the interaction face 76' of the endpiece.

10 The use of the ancillary tool 1 provided with the endpiece 6' is substantially similar to the use described previously. During the application of the effort of impaction, the force is essentially transmitted to the acetabulum by the truncated surfaces 74' of the petals 68'.

Figure 6 shows a variant of the ancillary tool 1 which essentially differs
15 from the tool of Figures 1 to 3 by the following:

Contrarily to the manipulation handle 16 of the preceding Figures, which is rigidly connected to the rod 10, the ancillary tool of Figure 6 comprises a manipulation handle 100 which is connected to the grip 46 screwed on the rod 10. The use of this variant is substantially similar to that of the tool of Figures 1
20 to 3, the user having, in order to provoke the displacement of the head 34 in translation with respect to the rod 10, to apply a movement of rotation on the grip 46/handle 100 assembly, for example by gripping the handle 100 in one hand and the knob 12 with the other hand.

Various arrangements and variants of the ancillary tool according to the
25 invention may also be envisaged:

- materials other than polyacetal may be used for making the supply body of the endpiece 6, the materials retained having both to combine a good shock

resistance by reason of the transmission of the efforts of impaction, and a good resistance to sterilization, and not to damage the inner wall of the acetabulum to be implanted; and/or

- the endpiece added to the distal end of the handle of the ancillary tool is
- 5 formed in one piece, for example of synthetic material, formed by a supple part comprising a ring which is radially deformable in homogeneous manner, similar to ring 66, and by a more rigid part, for example of reinforced material, in which the handle is removably connectable.

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